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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/656,182

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Allen McTeer

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EXAMINER

LEE, EUGENE

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 11/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/656,182

Applicant(s)

MCTEER, ALLEN

Examiner

Eugene Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 August 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 74-80,82 and 83 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 74-80,82,83 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 74, and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okada 6,424,036 B1 in view of Tsai et al. 6,479,398 B1. Okada discloses (see, for example, FIG. 5) a semiconductor device comprising a protective insulating film (dielectric layer) 2, semiconductor substrate (substrate) 1, first barrier metal film (barrier layer) 14, copper pad film (copper layer) 19, and final protective insulating film (insulating layer) 16. In column 9, lines 9-10, Okada discloses the copper pad film having a thickness of 1.5 um or 15000 Angstroms (500 Angstroms to about 20,000 Angstroms). Okada does not disclose said copper layer having titanium implanted within and near only an upper surface of said copper layer. However, Tsai discloses (see, for example, FIG. 2c) a copper alloy film comprising a copper layer 26, and a copper alloy film (implanted with titanium) 27. In column 5, line 47, Tao discloses titanium as an alloying element. It would have been obvious to one of ordinary skill in the art at the time of invention to have said copper layer having titanium implanted within and near only an upper surface of said copper layer in order to improve electromigration resistance.

Regarding claim 75, Okada in view of Tsai does not disclose said titanium implanted within said upper surface of said copper layer having a thickness of about 50 Angstroms to about 200 Angstroms. However, the thickness is a result effective variables that one of ordinary skill

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in the art would optimize for improving electromigration resistance. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said titanium implanted within said upper surface of said copper layer having a thickness of about 50 Angstroms to about 200 Angstroms, since it has been held that discovering the optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980).

3. Claims 76 thru 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okada '036 B1 in view of Tsai et al. '398 B1 as applied to claims 74, and 75 above, and further in view of Hsu et al. 5,661,082. Okada in view of Tsai does not disclose a passivation layer formed in contact with said copper layer. However, Hsu discloses (see, for example, FIG. 10) a bond pad comprising an antireflective coating (passivation layer) 393. In column 3, lines 38-41, Hsu discloses the antireflective coating comprising silicon nitride. It would have been obvious to one of ordinary skill in the art at the time of invention to have a passivation layer formed in contact with said copper layer in order to protect the copper pad film and prevent reflection.

Regarding claim 77, see, for example, FIG. 10 wherein Hsu discloses a via formed in the antireflective coating.

Regarding claim 78, Okada in view of Tsai does not disclose said dielectric film being formed of a material selected from the group consisting of phosphosilicate glass, borophosphosilicate glass, silicon oxide, silicon nitride, and silicon oxynitride. However, Hsu discloses (see, for example, FIG. 10) a bond pad comprising an insulating layer (dielectric film) 36. In column 3, lines 14-17, Hsu discloses the insulating layer comprising phosphosilicate

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glass, and borophosphosilicate glass. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have said dielectric film being formed of a material selected from the group consisting of phosphosilicate glass, borophosphosilicate glass, silicon oxide, silicon nitride, and silicon oxynitride in order to have a material that provides an adequate base for the copper pad film.

4. Claims 79, 80, 82, and 83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Edelstein et al. 6,457,234 B1 in view of Harada et al. 5,565,378 in view of Mahulikar et al. 5,320,689. Edelstein discloses (see, for example, FIG. 7A) a conductive pad comprising a metal layer (conductive bond pad) 54, and metallic layer (titanium-aluminum-copper-nitrogen layer) 52. In column 3, lines 20-21, Edelstein discloses the metal layer is open to the atmosphere (copper oxide layer). In column 3, lines 17-18, Edelstein discloses the metal layer may be copper. In column 4, line 38, Edelstein discloses the second metal layer may be aluminum. In column 4, lines 47-54, Edelstein discloses the metallic layer is an alloy derived from the metal layer and the second metal layer. In this case, the alloy is AlCu. Edelstein does not disclose the titanium of the titanium-aluminum-copper nitrogen layer. However, Harada discloses (see, for example, column 6, lines 54-61) an aluminum alloy film, which may have titanium added. The metal element enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the titanium of the titanium-aluminum-copper nitrogen layer in order to enhance the resistance to electromigration.

Edelstein in view of Harada does not disclose nitrogen of the titanium-aluminum-copper nitrogen layer. However, Mahulikar discloses (see, for example, abstract) a composite copper

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alloy wherein the copper alloy is formed with nitrogen. The copper alloy has improved tribological and mechanical properties while maintaining useful electrical conductivity. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the nitrogen of the titanium-aluminum-copper nitrogen layer in order to improve tribological and mechanical properties while maintaining useful electrical conductivity.

Regarding claim 82, Edelstein in view of Harada in view of Mahulikar does not disclose said copper oxide layer having a thickness not greater than 300 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of a copper oxide layer in order to adequately protect an underlying layer. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said copper oxide layer having a thickness not greater than 300 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of a copper layer in order to adequately protect an underlying layer. See *In re Aller*, 105 USPQ 233.

Regarding claim 83, see, for example, FIG. 7A wherein Edelstein discloses a wirebond (electrical conductor) 58.

Response to Arguments

5. Applicant's arguments with respect to claims 74-80, 82, and 83 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

INFORMATION ON HOW TO CONTACT THE USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Eugene Lee
October 29, 2006

EUGENE LEE
PRIMARY EXAMINER

A handwritten signature in black ink, consisting of a stylized 'E' followed by a large, loopy 'L' and a trailing flourish.